Labotronics



High Speed Centrifuge

LB-72HSC

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1. Safety Measures

1) To ensure safety and centrifugal effect, the instrument must be placed on a strong, shock-proof, horizontal surface, and ensure the balance of the four legs.
2) Before the centrifuge is used, the foreign matter in the centrifuge chamber is removed. Check whether the rotor body is installed on the rotor seat correctly, to ensure good connection. The screws connecting the rotor to the motor shaft must be screwed tightly.
3) Strictly by the rotational speed allowed by the rotor and strictly prohibit the maximum speed running over the rotor design.
4) It is forbidden to use the rotor unbalance. The centrifuge tube must be placed symmetrically and cannot be operated singly. The solution must be uniform to ensure the balance operation.
5) No rotor with high speed operation is strictly prohibited.
6) When you take out the rotor, you must use the special handle that the machine is equipped with, or gently tap the rotor body with non-metal tools, such as the screwdriver handle, and then repeat until the connection between the loosening rotor body and the motor shaft. To avoid damaging the flexible support of the motor, the screw is hard to be pulled up directly with the hand.
7) Before use, check whether there are cracks, corrosion marks and aging phenomena in the rotor and centrifuge pipe. If necessary, replace immediately. No cracks or corroded rotors are strictly prohibited.
8) Check whether the external power supply meets the requirements and the instrument is reliably grounded.
9) The centrifuge cannot be moved during the operation of the centrifuge, and the door cover is strictly prohibited. The door cover should not be opened when the motor and rotor are not completely stopped.
10) After the instrument or rotor is stopped for three months, it must run at a low speed for 10 minutes before it is allowed to run at the maximum speed of the rotor.
11) Do not mix the rotor of other units to prevent damage to the instrument and personal safety.
12) Do not place liquid containers on the instrument. If the container is upset, the liquid may enter the centrifuge and corrode its mechanical parts or electrical components.
13) After the separation, the instrument should be wiped clean, and the power switch of the instrument should be turned off and the power plug unplugged.

2. Introduction

High Speed Centrifuge LB-72HSC is an intelligent unit with microcomputer control and automatic rotor identification system. Features 4×100 ml of capacity and 18000 rpm speed with 31115×g of RCF. Ergonomic design with noise reduction system and automatic lid lock, has dual operation modes and also offers parameters revision during running operation.

3. Features

1. An intelligent high-speed centrifuge with microcomputer control
2. Automatic rotor identification system with rotor lock
3. Stainless steel structure with anti-corrosion coating treatment
4. Automatic lid lock with one-press centrifuge cover closure
5. Over speed, over heat, and unbalance protection for safe operation
6. Noise reduction system for quiet and smooth operation
7. Linear drive with 10 kinds of acceleration and deceleration
8. Compact, safe and reliable unit to achieve optimum centrifugation

4. Specifications

Model No.	LB-72HSC
Max speed	18000 rpm
Max RCF	31115 × g
Max capacity	4 × 100 mL
Revolution/min	± 10 r/min
Noise	≤ 62 dB
Time control	1 sec to 99 h 59 min
Power supply	AC 220 ± 22 V, 50 Hz
Power	750 W
Dimension (W×D×H)	480×360×330 mm
Weight	38 kgs

5. Applications

High Speed Centrifuge is used across cellular biology, biotechnology, research, genomics, diagnostic and clinical biology to acquire rapid precipitation of the sample, extract serum from blood, microcell separation, microbiological sample treatment, PCR experimental zone centrifugation, etc.

6. Instrument Introduction

Appearance and structure
(This picture is for reference only, subject to the actual model)

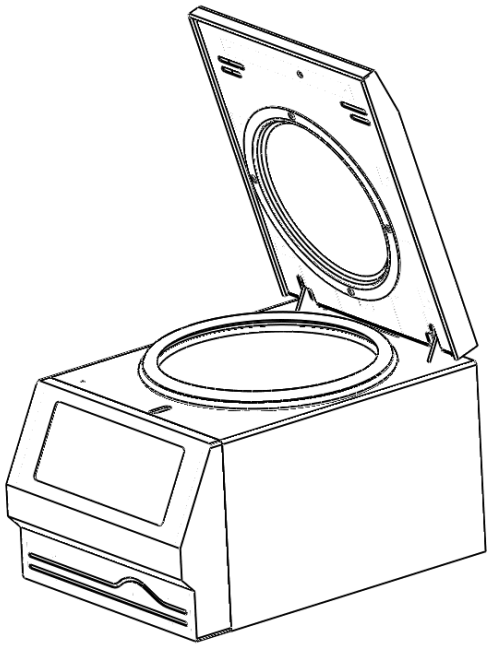


Figure-1

7. Installation

7.1 Installation Site Requirements

1) The installation desk should be sturdy, indoor, dry, and clean, avoid direct sunlight.
2) There is no strong vibration source near the centrifuge.
3) The normal type of centrifuge working environment of the indoor temperature freezing machine should be within the scope of 10~30 ℃, non-frozen in the range of 5 ~ 40 ℃, and the relative humidity should be less than 80%.
4) The heat source should be avoided around the centrifuge.
5) The room should have an independent ground line to ensure the safety of electricity.

7.2 Installation of Main Engine

1) The main engine is mounted to the solid surface, to ensure four footing contact surfaces.
2) The clearance between the centrifuge and the wall should be greater than 20 cm to ensure good ventilation.

7.3 Power Requirements

1) The power requirements are single-phase AC 60Hz power supply, the voltage is 220V, the voltage requirement is stable, the fluctuation requirement is between 10%, and the rated current is referred to the operation guidelines for each type.
2) The power supply voltage should be as specified on the machine nameplate. The voltage meter is used to detect the voltage.
3) If the power supply voltage and the rated voltage are more than 10%, the power supply does not meet the requirements of installation. (If the power supply voltage cannot meet the requirements, it is suggested to be equipped with a fully automatic electronic AC voltage regulator purifier).
4) The user can meet the requirements of the operation guide for each machine, the power plug and socket or circuit breaker, the position of the socket or breaker is not more than 1 meter from the centrifuge position.
5) To ensure safety, the centrifuge should be connected with a remote emergency switch (the switch is the best on the outside of the centrifuge in a room near or outside), which can be used in the event of a failure to cut off the centrifuge and the main power supply connection.
6) Make sure that the socket you want to use is properly connected and grounded. Never use a three-wire to second-line switch plug and never use a two-wire extension cord or a two-wire grounded multi-port terminal.

7.4 Typical structural rotor assembly and dismantling method

1) Assembly and dismantling method of angular rotor

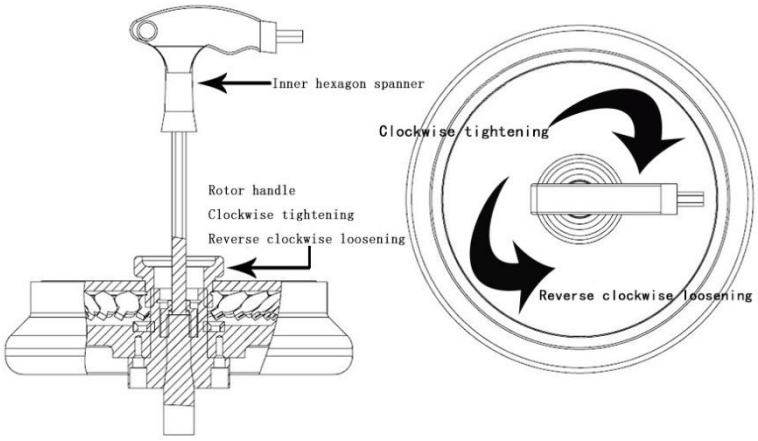


Figure-2

Note: Part of the rotor has a rotor cover, refer to the above picture to remove the rotor cover.

2) Horizontal rotor assembly and dismantling method

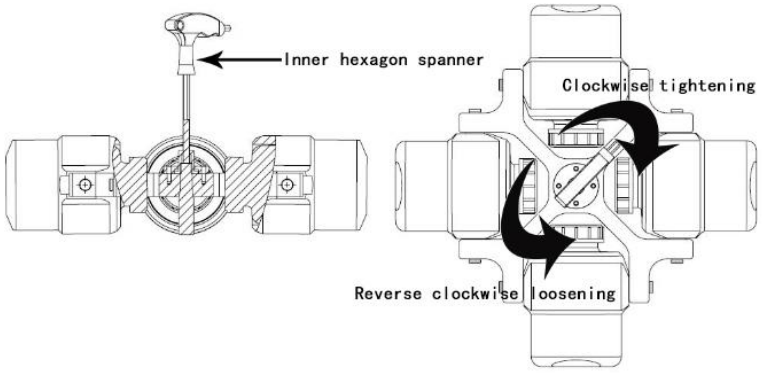


Figure-3

8. Working Principle

Centrifugation is the principle of centrifugal sedimentation, which allows cells (particles) of different densities in solution to be separated, condensed, or purified by centrifugal force.

1) Principle of centrifugal separation

Instruments to generate centrifugal force in the process of operation, settling due to centrifugal force effect, make the suspended substances in the liquid precipitation, than the largest significant material to the rotor radius direction, and the proportion of light materials deposited on the proportion of heavier material, is the proportion of different material layers to separate.

2) Calculation of centrifugal force

The separation is determined by the relative centrifugal force (RCF), and the centrifugal force is determined by the speed of N (rpm/min) and the centrifugal radius R (cm). Relative centrifugal force calculation formula of RCF=11.18 x R x (N/1000) - 11.18, conversion coefficient is based on the acceleration of gravity (1g=9.81m/s -) calculated the approximate conversion coefficient, thus the results should be the product of the results with the acceleration of gravity.

$$RCF = 1.118 \text{ x } 10\text{-}5n2r \text{ x } g$$

n---------- rotational speed (rpm/min)
r---------- rotation radius (cm)

3) Determination of centrifuge time

The time required for the separation and precipitation of particles in the mixture Ts is calculated by the following formula:

$$T_S = \frac{27.4 \times \left(\mathrm{Log_e R_{max}} - \mathrm{Log_e R_{min}}\right)\mu}{n^2 r^2 (\sigma - \rho)}_F$$

R max--------The radius of rotation of the test fluid at the far end of the axis.
R min--------The rotation radius of the test fluid from the nearest to the axis.
ρ----------Mixture density (g/cm3)
μ----------Mixture viscosity (mooring)
n----------Rotational speed (rpm/min)
r----------Particle radius (cm)
σ----------Particle density (g/cm3)

- In the same centrifugal force, the centrifugal time is inversely proportional to the proportion of material separated in the test fluid. The material is shorter than the significant separation time, and the proportion is small, and the separation time is long.
- In the same matter, the separation time is inversely proportional to the centrifugal force, the centrifugal force is large, the separation time is short, the centrifugal force is small and the separation time is long.
- With the same centrifugal force, the centrifuge time is related to the minimum radius, so the separation time is difficult to calculate, which is generally determined by the experiment.

9. Operations

9.1 Operation Panel

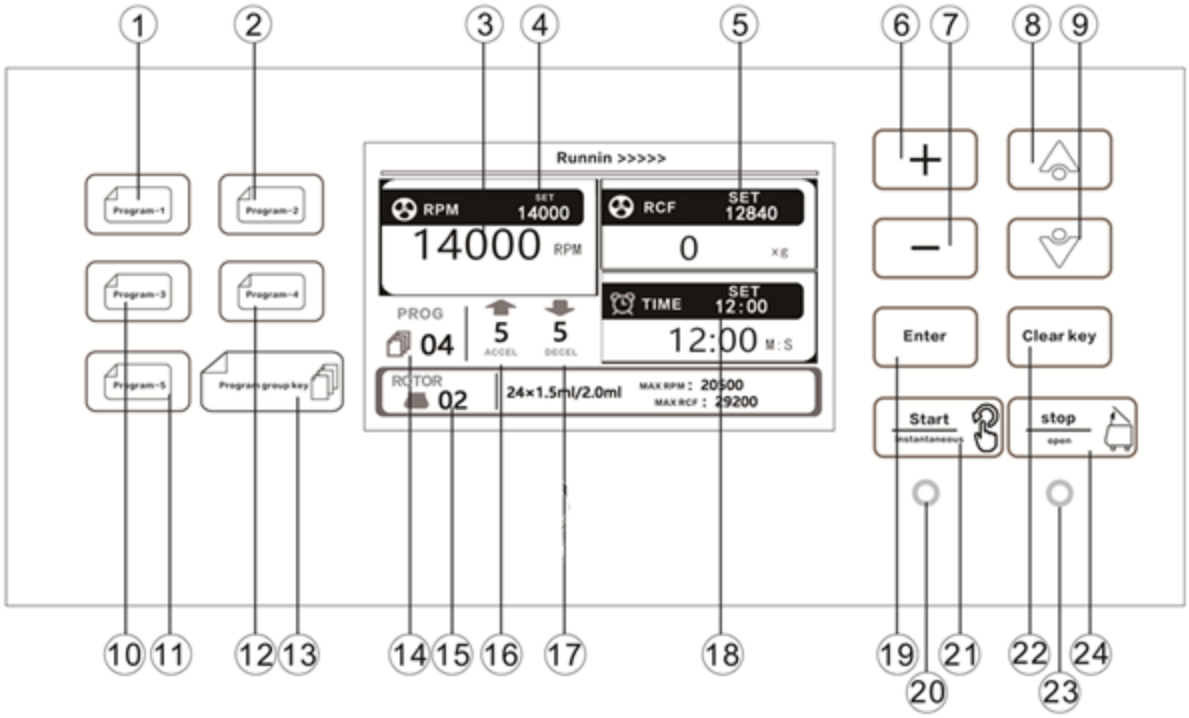


Figure-4

1. Program-1
2. Program-2
3. Actual speed value
4. Speed setting
5. Centrifugal force setting
6. Increase key
7. Decrease key
8. Up key
9. Down key
10. Program-3
11. Program-5
12. Program-4
13. Program group key
14. Program group key
15. Rotor setting
16. Acceleration gear
17. Deceleration gear
18. Time setting
19. Conformation key
20. Operation indicator
21. Start/instant key
22. Clear key
23. Stop indicator
24. Stop/open key

The operating procedures of the instrument are as follows:

1) Place the centrifuge on the platform, visually balance it, and gently shake it by hand to check whether the centrifuge is placed stably.
2) After confirming that the placement is stable, turn on the power supply, press the power switch, and then press the "**Stop/Open**" key to open the door cover.

3) Open the door cover, gently place the selected rotor on the motor shaft, screw in the screw to tightly connect the rotor and the motor shaft (note that the action should be gentle and careful to avoid large shaking left and right and pulling up and down to avoid damage to the flexible support of the motor), then put the hanging cup or adapter with test tube on the rotor, and then rotate the rotor body slightly after the completion, the rotor should rotate flexibly, and the hanging cup (adapter) should tilt freely on the rotor, No blocking and rubbing.
4) Place the centrifuge tube containing the same amount of test solution into the rotor suspension cup (test tube) symmetrically to ensure the balanced operation of the rotor.
5) Close the door cover and check whether it is locked properly (lift the door cover gently and forcefully after closing, and the door cover will not open. If the door cover is not closed properly, press "**Start**", and the "**Time Display Window**" window will display "**E3**").
6) Set rotor number, speed, time and other operating parameters.

Functional key parameters:

1. When the parameter needs to be adjusted, move the cursor to the corresponding option on the display screen through the "**Up**" or "**Down**" key, adjust it to the required condition with the "+" or "-" key, and press the "**OK**" key to confirm and save the parameter. The adjustable parameters include "**program group**", "**speed**", "**time**", "**rotor**", "**acceleration**", "**deceleration**" and "**centrifugal force**".
2. In the shutdown state, the "**Program 1**"～"**Program 5**" keys are used to quickly call the corresponding program group parameters. The "**Program**" key moves the shortcut cursor to the program group position.
3. The program group and rotor number cannot be changed during the operation of the instrument. Only "**speed**", "**time**", "**acceleration**", "**deceleration**" and "**centrifugal force**" can be modified during the operation.
4. When the status of the centrifuge is "**stop**" or "**time is up**", press the "**start**" key to run the indicator light on, the speed starts to rise until it stabilizes at the set value, the speed display window is the actual speed of the rotor, the temperature displayed in the temperature window is the actual temperature in the centrifuge chamber, and the time of the time display window is decreasing.
5. When the time returns to 0 or the "**Stop**" key is pressed, the buzzer will give an alarm, the stop indicator will flash, the rotation speed will start to drop, and when the speed drops to 0 r/min, it means that the machine has stopped, the stop indicator will always be on, and the buzzer will give an alarm (press any key to clear the alarm). At this time, the door cover of the centrifuge chamber can be opened, and the centrifuge sample can be taken out.
6. When the speed displays "0", the "**door open key**" opens the door electrically. When there are different centrifugal demands, different parameters can be saved through program group parameters. When the cursor moves to the "**program group**" parameter through the "**up**" or "**down**" key, the "+" or "-" key adjusts the program group, and sets the rotor, speed, acceleration, deceleration, etc.

7. Under the current program group, then press the confirmation key to save the parameter to the current program group. By analogy, you can set up to 99 different program groups. When you need to call the saved parameters, you only need to call the corresponding program group.
8. When selecting the parameters corresponding to "**program**" with the "**up**" or "**down**" key, use the "+" or "-" key to adjust it to the program to be used. The system supports a total of 10 gears from 0 to 9, with 0 being the fastest and 9 being the slowest. When the angle rotor or horizontal rotor with large volume is used, the slower gear can be selected, and other gears can be selected.

7) Finally, carefully check the parameters on the screen and the parameters to be set. After confirmation, press the "Start" key to start the instrument and enter operation.
8) When the running time counts down to "0", the centrifuge will automatically stop, and the buzzer will beep. When the speed is 0, press the "**Stop/Open**" key to open the door cover. Press the "**Stop/Open**" key in case of emergency during operation, and the buzzer will not ring when the centrifuge stops running.
Note: Don't open the door frequently. The recommended interval is 10 seconds to avoid damage to components.
9) Open the door cover and carefully take out the centrifuge tube to complete the whole separation process.
10) Turn off the power switch and cut off the power supply of the centrifuge.

9.2 Centrifuge Tube Placement

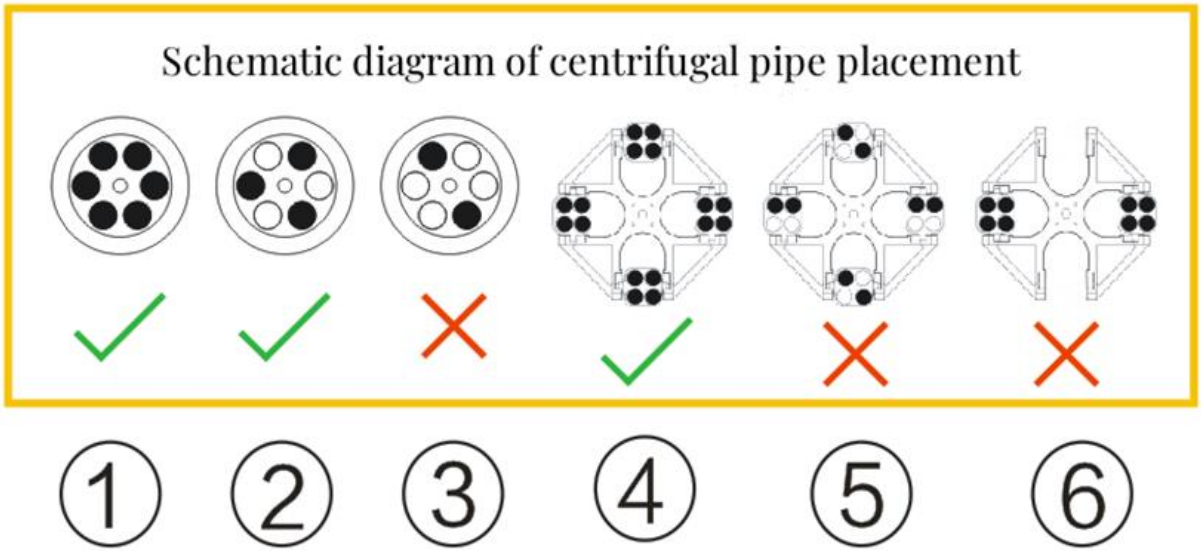


Figure-5

1) Figure 1 shows the normal condition, where a 6-hole centrifuge tube is filled with the rotor to keep a 6-point balance force.
2) Figure 2 shows the 3-point balanced placement of fewer samples.
3) Figure 3 shows that, though the 2-point is balance when two test tubes are placed, at high speed, there will be large, unbalanced resonance points in the region of resonance points of rotation.

4) Figure 4 shows the normal condition of the horizontal rotor. When the rotors are filled with centrifuge tubes, the symmetrical 4-point force-balanced.
5) Figure 5 shows an example that does not follow the principle of point symmetry, which will increase vibration in the resonance region.
6) Figure 6 is a schematic diagram of the horizontal rotor with two hangers. Due to the large radius of the horizontal rotor, the uneven imbalance caused by it will be greater, and the long-term use in such working conditions, the drive motor bearing wear will be more serious than normal circumstances. The horizontal rotor radius of two symmetrical points is usually smaller.
7) Centrifuge is a high-speed rotating instrument, in the process of use, due to the motor shock absorption, we cannot perceive the vibration inside the machine. As a professional centrifuge manufacturer, we need to simulate the various use states, through the summary of various data design, to make the product in a good state for a long time.

9.3 Introduction of Centrifuge Active System

1) Main current protection setting. When the power supply current exceeds the rated value, the miniature circuit breaker will protect the main machine, and the "**overcurrent protection**" will be displayed on the top of the machine screen.
2) Overspeed protection device. When the speed is out of control or exceeds the pre-selected speed of ± 300r/min (overspeed treatment can be carried out only after the control system confirms that the speed is stable).
3) At this time, the buzzer will alarm, the top of the machine screen will display "**overspeed**", and the control system will automatically enter the shutdown step to stop the motor, prevent the machine from overspeed, and protect the machine and personal safety.
4) Unbalance protection device. When the vibration amplitude of the machine due to unbalanced operation exceeds a certain amount, the buzzer will alarm. The top of the machine screen displays "**unbalance**".
5) At this time, the buzzer will alarm, and the control system will automatically enter the shutdown step to stop the motor, prevent the machine from causing mechanical vibration due to unbalance, and protect the machine and personal safety.
6) **Door opening protection:** The door cover is not closed or not closed properly, the door lock sensor is faulty, the door protection detection cannot operate when no signal is detected, the buzzer alarms, and the top of the machine screen displays "**The door is not closed properly**", at this time, the instrument cannot start.
7) When the door is opened during operation, the buzzer will alarm and shut down, and the control system will automatically enter the shutdown step to stop the motor, prevent the door from running, and protect the machine and personal safety.
8) When the above prompts appear on the top of the machine display screen, the buzzer will beep for a long time and shut down. The display prompt can be released only after the fault is removed, and the instrument can be started only after the fault is removed.

9) This machine is equipped with a fault display window. When the machine fails, the following characters will be displayed in the "**Information Window**" column (at the top of the display frequency), with the following meanings:

Unbalance	Unbalance
Over-speed	Over-speed
Lid-open	Lid-open
Lid exception	Lid exception
Temperature sensor error	Temperature sensor error
Motor stall	Locked motor
Communication error	Communication error
System error	System error
Voltage protection	Voltage protection
Overcurrent protection	Overcurrent protection
Motor error	Motor error
Brake resistance	Brake error
Time out	Time out
Rotor error	Rotor error

10. Maintenance

10.1 Maintenance of the Centrifuge

1) The centrifuge should use the AC220V 60Hz AC circuit, and ensure the voltage stability; such as user voltage instability, suggestions for the machine is equipped with automatic electronic AC voltage stabilizing purifier, so as not to damage the centrifuge; should be installed in a strong and stable, the level of the ground, the chassis around leave some space to maintain good ventilation.
2) The time interval of reopening is no less than 5 minutes after each shutdown (power off), so as not to damage the compressor. The centrifuge shell should be kept clean and dry. Dry/wet cloth is scrubbed, neutral detergent can be used, but acid/alkaline detergent cannot be used.
3) The centrifuge room should be kept clean and dry. When there are foreign objects in the centrifuge room, use a cloth or tweezers to remove the debris from the centrifuge room. It can be scrubbed with a dry/wet cloth. If necessary, it can be cleaned with neutral detergent, then rinse with clean water and dry. But acid/alkaline, corrosion resistant solvents, and chlorine containing disinfectants cannot be used. It can be sterilized with 70% alcohol.
4) For radioactive contamination, it is cleaned by using the same amount of 70% alcohol, 10% SDS, and water mixture, then cleaned with alcohol and deionized water, and dried with a dry soft cloth. In the normal operation process, due to air and low temperature, the centrifugal cavity wall contacts, dew, should be dry in time to prevent frosting.
5) If frosting occurs, the rotor can be pulled out, and the centrifugal chamber door is closed. The setting temperature is 25 degrees. When the temperature reaches 20 degrees, the chamber door is opened, the wall of the centrifugal chamber is wiped away, the rotor is set up, and the required temperature is set.
6) Every time after using centrifuge, we should open the door cover, wipe the condensate water, and then dry it naturally. Before and after centrifugation, the rotor must be put down gently or vertically, so as to avoid collision of the shaft and the rotor itself.
7) The rubber seal ring is equipped at the upper part of the centrifuge chamber and the door cover, the rotor seat, and the bottom of the centrifugal chamber. With the extension of the time of operation, we should observe whether there is any deformation frequently, to prevent the external heat penetration and make the temperature control effect poor, and affect the centrifugal result. If it is found that the deformation or aging should be changed in time.
8) Regularly use compressed air (vacuum cleaner) to clear the dust of centrifuge ventilator and condenser, ensure ventilation effect and heat transfer effect of condenser, make refrigeration and heating effect better.
9) When the centrifuge is not used for a long time, the rotor body should be removed and the rust proof oil should be coated on the rotor seat or drive shaft, so as to prevent the rotor from rusting and not fit well with the rotor body, which will affect the balance effect when the instrument runs. When necessary, the desiccant can be placed in the centrifugal room to absorb the moisture and prevent the rotors (or the driving shaft) to rust.

10) The door cap pneumatic support rod should be regularly checked whether it can work properly, whether the connection is intact, if there is a problem of cracks, replace it immediately.
11) There must be special measures for safety and protection when centrifuging toxic, radioactive and polluted samples.
12) The operator should pay attention to safety matters: the rotary head should be fixed in the right position, the fixed screw should be tightened, check whether the parts such as rotary head and so on are cracked or corroded, and the ground wire contacts.
13) **Centrifuge function examination:** The operator should ensure that the important parts of the centrifuge are in good condition, which mainly refers to:
    - The installation of the motor is stable.
    - There is no deviation from the rotor (rotating shaft).
    - The rotor and accessories are not corroded.
    - Screw fastening;
    - The ground wire is connected reliably.

10.2 Maintenance of the Rotor

1) Before turning the head, it is better to pre-cool. After centrifugation every day, wipe off the residual liquid or water on the inner and outer surface of the rotor and centrifugal cup with a clean, soft cloth to dry for use. Temporarily unused rotor and centrifugal cup should be removed from the ventricle and stored separately in a clean and dry place. The rotor should not be coated with paraffin protection for a long time.
2) The centrifuge tube and the centrifugal cup must be used to ensure the quality, and the cleaning, disinfection, and maintenance should be paid attention to. Periodically check the inner surface oxidation layer of the rotor and centrifugal cup. If there is peeling, corrosion, or a serious scratch, deformation, and fine crack, it should be stopped.
3) The use of harmful gas or in a wet environment will accelerate the occurrence and expansion of the centrifuge rotor corrosion phenomenon and affect the service life of the rotor.
4) The rotor will leak when the centrifuge tube is damaged, filled or sealed. Rotor after use should be removed from the shaft, rotor timely cleaning, painting protective agent (if placed on the shaft for a long time, rotor and rotor contact under the action of compressive stress, the corrosion effect, it may be "killed" phenomenon).
5) To prevent corrosion and hidden trouble, it is necessary to pay attention to the filling amount of the centrifuge tube and the tight seal in the rotor, and check whether the sealing ring is in good condition. If aging and damage should be replaced in time to avoid leakage.
6) The corrosive solvent is placed directly with the rotor. After the rotor is used, it should be washed, wiped, and sprayed and applied to protect the oil.
7) In the use and preservation of the rotor, the rotor should be avoided from being bruised, scratched, and scraped as far as possible to prevent mechanical damage.

8) When taking the horizontal rotor with the wind shield, we should take the aluminum horizontal rotor body, take light and put light, prevent the deformation of the air cover outside the rotor, so as not to cause unbalance. When not used for a long time, the centrifuge cup should be removed and placed.
9) When the average density of the separated sample is greater than 1.2g/ml, the rotor is used at a reduced speed, and the formula is calculated as follows:

$$N = N_{max} \times \sqrt{1.2/\rho}$$

10) When the stainless steel centrifuge tube is used, the rotor needs to be reduced to use the rotor:

$$N = N_{max} \times (1 - 25\%)$$

Note: On the safety point of view, the permissible life of the rotor of the centrifuge metal is three years, and the allowable life of the non-metal rotor is one year. The rotor is beyond the allowable life period and must not be used again.
Warning: The rotor equipped with this machine is strictly forbidden to exceed the speed specified in the manual, and the damage caused by the use of super speed is self-negative. It is strictly forbidden to use cracked and corroded rotors.

10.3 Anti-pollution Measure

If centrifuges or rotors have been used to deal with radioactive samples or pathological samples, they should be treated in the following steps to prevent pollution.

1) Clean the centrifuge and rotor surface as described.
2) Take out the whole rotors.
3) Remove the motor seal ring and seal pad for cleaning.
4) Cleaning centrifuge door cover, centrifuge room and rotating shaft.
5) Cleaning of foreign body fouling near all motor and rotor seat.
6) Cleaning the rotor and the rotor wind hood.

In such a centrifuge or rotor that needs service, to protect the safety and take effective measures to deal with the risk, to ensure personnel safety and health.

11. Troubleshooting

Troubles	Cause	Solution
No display when power plugged in	No power	Power check
	Fuse blown	Check & replace
	Cable connection loose	Check & reconnect
Large vibration	Tube No Symmetrically placed	Check & adjust
	Tube broken	Check & replace
	rotor not tightened	Check & adjust
	Partial damage to shock	Check & replace
Display 0000, Start no running	Circuit board or transformer damaged	replace
	control system connector is loose	Re-tighten
	Key damaged	replace
	Motor damage or leakage	replace
Running but not at speed, the machine has a strange sound or smell	Control system or motor failure	Maintenance
The actual speed is different from the set or displayed speed, out of control, or unstable	Control system failure	Maintenance
The temperature can't meet the set low temperature requirements	Without precooling or insufficient precooling	Full precooling
	Compressor damage	Check & replace
	Solenoid valve damage	Check & replace
	Insufficient refrigerant	Fill with appropriate refrigerant

12. Rotor Selections

Rotor Type	Capacity	Maximum Speed	Maximum RCF
Angle Rotor 01	24×1.5/2 ml	18000 rpm	31115×g
Angle Rotor 02	12×5 ml	15000 rpm	18036×g
Angle Rotor 03	32×1.5/2 ml	14000 rpm	19940×g
Angle Rotor 04	8×8×0.2 ml (PCR row)	14000 rpm	15032×g
Angle Rotor 05	48×1.5/2 ml	13000 rpm	18327×g
Angle Rotor 06	12×10 ml	13000 rpm	15228×g
Swing-out Rotor 01	6×50 ml	13000 rpm	17146×g
Swing-out Rotor 02	6×50 ml	12000 rpm	16227×g
Swing-out Rotor 03	12×15 ml	11000 rpm	13730×g
Swing-out Rotor 04	4×100 ml	11000 rpm	14298×g
Swing-out Rotor 05	24×1.5/2 ml	13000 rpm	16816×g
Swing-out Rotor 06	4×100 ml	4500 rpm	3010×g
Swing-out Rotor 07	2×2×96 microplate	4000 rpm	2057×g
Swing-out Rotor 08	8×50 ml	4000 rpm	2680×g